DOCUMENT RESUME

ED 372 103 TM 021 823

AUTHOR Wilson, Linda D.
TITLE Assessment Reforms in Search of a Theory.
SPONS AGENCY Department of Education, Washington, DC.; National Center for Research in Mathematical Sciences Education, Madison, WI.
PUB DATE Apr 94
NOTE 16p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 4-8, 1994).
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Cognitive Structures; *Constructivism (Learning); *Educational Assessment; Educational Change; Educational Theories; Learning; *Mathematics Instruction; *Standards; *Theory Practice Relationship
IDENTIFIERS *National Council of Teachers of Mathematics; *Reform Efforts; Standard Setting

ABSTRACT

Examination of the development of the standards documents of the National Council of Teachers of Mathematics (NCTM) points to constructivism as the central view of learning that underlies the reform movement in mathematics education. Constructivism is a theory of how learning occurs. It assumes that knowledge is not passively received, but rather is actively built up by the subject during cognition. The function of cognition is seen as adaptive, and it is assumed that cognition serves the subject's organization of the experiential world. Constructivists view mathematics as socially constructed. Certain assessment practices are more compatible with constructivism than they are with other theories of learning. The assessment standards as they have been created cannot be called either constructivist or nonconstructivist. They are aligned with constructivism in some respects and represent constructivism as it is usually reflected in mathematics reform efforts. In other respects, they reflect the divergent opinions of a group who needed substantial compromise to arrive at a practical document. (Contains 19 references.) (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 372 103

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN **OTHER THAN PAPER COPY** HAS BEEN GRANTED BY

LINDA D. WILSON

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Assessment Reforms in Search of a Theory

Linda D. Wilson

University of Delaware

AERA

April 1994

This research was made possible through funding from the Office of Educational Research and Improvement, National Center for Research in Mathematical Sciences Education.

TM021823

BEST COPY AVAILABLE

Assessment Reforms in Search of a Theory

Introduction

What theory of learning undergirds the reform movement in mathematics education? What follows are some excerpts from the first two "standards" documents from the National Council of Teachers of Mathematics:

> ...learning does not occur by passive absorption...(NCTM, 1989, p. 10)
> This constructive, active view of the learning process must be reflected in the way much of mathematics is taught (NCTM, 1989, p. 10).
> ...learning occurs as student actively assimilate new information and experiences and construct their own meanings (NCTM, 1991, p.2)

These quotes, from the documents that have served to define the reform movement in mathematics education, point to constructivism as the central view of learning.

Constructivism is a theory of how learning occurs. It is not a theory of curriculum, nor of teaching, nor of assessment. Nevertheless, as Kilpatrick (1987) has pointed out, many constructivists have pointed to certain teaching practices, for example, and claimed that those practices presuppose a constructivist view of learning. Kilpatrick argues quite convincingly that such presuppositions are false, in that many of those so-called constructivist practices could just as easily comply with other theories of learning.

However, even if constructivism does not imply or prescribe certain practices, there is a widespread agreement that theories of teaching, curriculum, and assessment should be *consistent* with a certain theory of learning. If constructivism is the theory of learning, then a theory of assessment should not be contradictory with the fundamental assumptions of constructivism. Within a given system of education or body of research, consistency is valued as a means of giving coherence to different aspects of education. Galbraith, for example, asks

> Is it consistent to embrace a constructivist approach to teaching but then support assessment programs which deny the constructivist stance? Is it consistent to argue for school-based assessment on the one hand and to support statewide, national, or international competency testing on the other? (1993, p. 78)

Others have challenged the mathematics education community to "develop models of teaching which build on and are consistent with [constructivism]" (Simon, 1993, p.21). Ernest (1991) has developed a complete scheme for describing five different ideologies. For each one he identifies various theories, including views of mathematics and theories of learning, teaching, and assessment, that are consistent with that political ideology. So there seems to be some consensus as to the importance of consistency between and among various theories of learning, teaching, curriculum, and assessment.

But obtaining that goal may be difficult, at least in the case of more political reform documents. In this paper I will describe the creation and development of the working draft of the assessment standards for school mathematics, published by the National Council of Teachers of Mathematics (NCTM, 1993). An examination of this document, as it is being developed, will

show that constructivism may be the current buzzword in mathematics education, but those leading the efforts to reform assessment practice are not necessarily aligned with that theory. I will also argue that, while consistency of theories may be a laudable goal, in practice it may not be a practical one. In an ideal world an assessment theory would be developed that is consistent with the most prevalent theory of learning, and that theory would undergird the development of a document such as this one. In reality, however, the document necessarily represents the intersection of many different points of view about assessment, not to mention views of learning and teaching. Yet, as messy as this process is, I would argue that it is essential in the production of a document that truly represents mathematics education.

Fundamental assumptions of constructivism

Constructivism has existed long enough as a theory of knowledge acquisition that it has spawned several specialties, or subcategories, such as social constructivism or radical constructivism. As constructivism has become more popular in mathematics education, many find that some of its assumptions are easier to adopt than others. Radical constructivism is represented by the following three assumptions:

> 1. Knowledge is not passively received either through the senses or by way of communication. Knowledge is actively built up by the cognizing subject.
> 2. a. The function of cognition is adaptive, in the biological sense of the term, tending towards fit or viability.
> b. Cognition serves the subject's organization of the experiential world, not the discovery of an objective ontological reality. (von Glaserfeld, 1990, p.22-23)

The first of these assumptions is not as "radical" as the second, and has been adopted by many who call themselves constructivists but would not be willing to accept the second assumption, especially part (b). That is, ubiquitous phrases like "students construct their own knowledge" imply that the speaker or writer accepts the first assumption, but do not imply an acceptance of the second.

I would argue that it is this sort of "soft" constructivism that is currently prevalent among mathematics educators, but that the more radical variety has not gained wide acceptance. This is what Kilpatrick (1987) has referred to as "sort of constructivism." There is a willingness to adopt the idea that knowledge is not passively received, but rather actively constructed, by students, but the nature of that knowledge is still very much open to debate. Is there an external or objective reality that is discovered by the student, or is truth the "best informed construction about which there is presently consensus" (Galbraith, 1992, p. 74)?

For the purposes of this paper, I will adopt the stance of the radical constructivists. That is, when I use the term constructivism I will be referring to a theory that adopts all three of the assumptions noted above.

Assessment practices consistent with constructivism

Much of traditional assessment practice is based on behaviorist theories of learning (Romberg, Zarinnia & Collis, 1990). There are some fundamental principles of assessment that necessarily change when one takes a constructivist outlook on learning. The most basic of these is that the assessor can no longer presume to obtain a clear view of student learning solely on the basis of observable behavior. After all, the assessor is herself engaged in the act of constructing knowledge about the student's understanding, and the best that can be hoped for is some sort of fit between the assessor's model of the student's understanding and the student's construction of that knowledge. There is no "true" model that exists outside the understandings of those two participants. Thus assessment is necessarily a fallible and imperfect exercise. The assessor can't know what is inside the student's head, but is perpetually impelled to refine her model of the student's understanding.

Traditional forms of assessment, based as they are on a measurement model (Graue, 1993), tend to ask the question, Did the student "get it"? That is, did the student master whatever objectives were set for him? This implies the existence of an external truth that the constructivist must reject. Rather, the constructivist must ask the question, Where is the student in the process of constructing her knowledge about this concept? Here the assessor is asked to continually refine a model of the students's understanding. Assessment is then not something that is done at the end of instruction, to see if objectives were met, but is done throughout instruction as a way to enhance the teacher's understanding of what it is the student knows.

What to Assess

Constructivists view mathematics as itself socially constructed. This philosophy of mathematics has been characterized as "relativistic fallibilism" (Ernest, 1991). This entails seeing mathematical knowledge as quasi-empirical and corrigible. Mathematics is both value-laden and culturally bound in this perspective. This view of mathematics, differing as it does from the historically absolutist view, first emerged in the writings of Lakatos (1963-64). In 1967 mathematics educators in Britain expressed the view this way:

> Mathematics is made by men and has all the fallibility and uncertainty that this implies. It does not exist outside the human mind, and it takes its qualities from the minds of men who created it. Because mathematics is made by men and exists only in their minds, it must be made or re-made in the mind of each person who learns it. In this sense mathematics can only by learnt by being created.
> (Wheeler, quoted in Ernest, 1991, p.205)

In terms of what to assess, this perspective represents a shift from "objective truths" to "socially-constructed truths." It also implies that mathematics is a dynamic, ever-expanding body of knowledge, not a static and finite set of "truths."

If mathematics is seen as culturally embedded and socially constructed, then school mathematical knowledge would take the form of socially embedded mathematics, rather than a body of decontextualized knowledge. The emphasis

would be on the mathematics that arises from culture or social issues, and mathematics would be seen as a tool for solving problems that are socially embedded.

A constructivist who is planning for assessment would be less interested in questions such as, "Does the student 'get it'?" or "Can the student reproduce the mathematics?" and more interested in deeply probing the ways the student may be constructing mathematical knowledge. Questions to ask would be more like, "What can the student do with these mathematical ideas?" or "Even if they're producing wrong answers, are they constructing in a way that is mathematically recognizable? (Nodding, 1990, p. 14)". There is a shift, then, from reproduction of mathematics to the production of mathematics.

The goal of assessment from a constructivist point of view is to make ever more accurate models of student thinking. The assessor would attempt to describe the structures of mathematical understanding that the student is perpetually building. Because each student's mental structure is unique and contextually dependent, the task is neither trivial nor straight forward. The a priori assumption must be that each individual's world experience, including their construction of mathematics, is ultimately inaccessible to others. How, then, can a constructivist carry out an assessment?

Assessment methods

Goldin (1990) asserts that assessment must take the form of descriptive case studies, rather than any kind of controlled experimentation, since the cognitions of individuals are simply not comparable. Rather than being viewed as a supplement, or a precursor to other kinds of research or assessment, he argues that case studies are the only kind of assessment that is feasible under a constructivist framework. This method was described by Confrey:

> Teachers must build models of student's understanding of mathematics. To do this, teacher need to create as many and as varied ways of gathering evidence for judging the strength of a student's constructions as possible. The result will be that a teacher creates a "case study" of each student. (1990, p.112)

In order to build a valid model of a student's mathematical thinking, the assessor must use more sophisticated diagnostic tools than might otherwise be required. Clinical interviews designed to probe the child's conceptions or misconceptions might be one useful method. Students might be asked to engage in think-aloud protocols to describe their thinking as they solve mathematical problems. The assessor, in other words, must play the role of a cognitive researcher, using all the tools of that trade to construct a reasonable model of what the child has constructed.

Of course the assessor is herself constructing knowledge about what the student knows, so that the resulting model is at best a fallible facsimile of the student's cognitions. As von Glaserfeld (1990), Confrey (1990) and others have said, it is not possible to reproduce the constructions of another. Such models are necessarily hypothetical. The assessor may use his own mental structures as a way of understanding those of another, but these can only be considered as heuristic devices (Goldin, 1990). While they may shape the emerging theories about what the students has constructed, they must be

tempered with and informed by other empirical means of gathering evidence.

There are, no matter what theory of learning one holds to, only three basic ways of gathering evidence about student learning. These are observations, interviews, and the examination of written products. While it may be true that, as a clinical researcher, the constructivist teacher is compelled to make great use of observations and interviews, one cannot claim that such techniques are "constructivist techniques" of assessment. In fact, the call for the documentation and use of observations in the classroom, for example, was made long before constructivism came on the educational scene. In the 1946 yearbook of the National Society for the Study of Education, a chapter on "Obtaining Evidence of Understanding" calls for teachers to employ such methods:

> The evaluation of understanding does not, in general, require new devices and procedures. The teacher should depend upon normal classroom opportunities, the examination of pupils' work products, written tests of different kinds, pupil interviews, and the systematic observation of pupil behavior.
> ...The day-by-day observations of alert teachers provide the most significant evidence of pupils' understanding.
> ...The things which pupils do and say in the course of the regular daily program, when properly noted and interpreted, are the richest source of information about what pupils understand, and how the understanding is acquired (Findley & Scates, 1946, p.45)

These quotes serve as a reminder that many of the techniques of assessment that may be implied by constructivism might be aligned with other theories of learning as well.

Role of the teacher

The assessment methods that have been outlined above imply a certain role for the teacher. To state it succinctly, the teacher is being asked to perform the role of a cognitive researcher, employing primarily qualitative means of collecting and analyzing data about students. The goal of assessment is to construct viable models that describe students' constructions of mathematics, and the methods used are those of a researcher who is trying to produce a case study for each student.

Just as there is no single view of teaching that could be called "constructivist" (Simon, 1993), there is no single method of assessment that a teacher must employ. But in order to produce the most valid inferences about what a student knows or understands, the teacher must necessarily gather evidence from multiple sources. Just as for a researcher there are three modes of gathering information (observations, interviews, and documents), so the teacher is expected to make use of evidence gathered through observing students, talking with and listening to students, and through the examination of students work. All three types of evidence must then be triangulated to build a valid model.

In a constructivist classroom, the teacher would create an environment where assessment and instruction are thoroughly integrated. In order to probe deeply into the students' mental constructions, the teacher would foster

activities that encourage students to express their thinking verbally, as well as in writing. Conflicting points of view would be encouraged,a nd the emphasis would be on the communication of mathematical ideas. The teacher might employ group problem solving activities that would enable her to better observe the students interacting with each other. The teacher will have to ask probing questions that elicit illuminating responses from students about how they are constructing certain ideas. The emphasis in the classroom would be on communication, including argumentation, making conjectures, clarifications, and questioning. The role of the teacher is to foster as much of this activity amongst students as possible, in order to gain insight into how students are constructing mathematical ideas.

Above all, the teacher must sharpen his observation and listening skills. This alone represents a radical change in the role of the teacher. Yackel et al describe this change:

> Most teachers express the view that once you 'start listening' to the children and try to make sense of their thinking, you find that it is not possible to judge from their answer alone whether or not they 'understand.' ...The teachers become intimately knowledgeable about their individual students' mathematical thinking by listening and intervening in their small group problem solving activity and by interacting with them as they give explanations and justifications in whole class discussions. (1993, p. 77)

Assessment and teaching in a constructivist classroom are necessarily integrated, for "the most basic responsibility of constructivist teachers is to learn the mathematical knowledge of their students and how to harmonize their teaching methods with the nature of that mathematical knowledge" (Steffe & Wiegel, 1992).

Role of students

If the fundamental role of the teacher is to assess the mathematical knowledge of the students and make instructional decisions based upon that evidence, then the central role of the student in such a classroom must be to communicate what he or she understands. Rather than parroting the knowledge transmitted by others, the student must help the teacher create a viable model of the student's own construction of mathematical ideas. There is no way for the teacher to make valid inferences about what the student has constructed without relying on some sort of communication from the student. This might take the form of speaking directly to the teacher, discussing mathematical ideas with other students, or communicating through writing or through the creation of products. It might mean using explicit body language to help the teacher learn what kinds of conceptions he or she holds.

The primary emphasis is necessarily on multiple and varied means of communication, and the communication itself has to be of a breadth and depth that most completely portrays the conceptual understandings of the student. While any written work would presumably give the teacher some information, arguments, conjectures, explanations, and multiple representations are likely to provide a better picture for the teacher. Likewise in oral communication, "good questions" (Sullivan & Clarke, 1991) will elicit more complete portrayals of student thinking than "leading questions."

Rather than assessment being something that is "done to students," assessment in a constructivist classroom takes the form of a partnership between student and teacher. Students will become better at communicating their thinking when they are engaged in both self assessment and peer assessment. That is, when students are routinely asked to respond to questions such as, What is it that I understand about asymptotes in a hyperbola? they become more attuned to ways of communicating this thinking to the teacher. Likewise, when they are put in the role of having to make inferences about what another student knows they gain an appreciation for the complexities of making viable models of another person's thinking.

Purposes of assessment

In a measurement model of assessment, the primary purpose is to rank order students according to certain traits, whether it be aptitude, achievement, or other accomplishments. Methods of assessment are then chosen according to how well they discriminate between one student and another. The ultimate goal is to compare students with one another and produce a score that validly represents how one student compares with another, or with all the others. Norm-referenced tests and percentile scores are based upon this fundamental idea. As noted above, however, such a view of assessment presents contradictions for a constructivist. Given that each individual's constructions of mathematics are unique and inaccessible to others, the notion of rank ordering students no longer makes sense (Romberg, Zarinnia & Collis, 1990).

Rather than judging whether students have obtained some objective truth and then rank ordering them on this trait, the constructivist must ask different questions. Instead of asking whether or not the students have "gotten it," the constructivist is interested in the nature of the constructions the student has built for a concept, with the primary purpose of assessment to give feedback to student and teacher about the kind of further instruction that might be needed. The constructivist would be less interested in how Tonya is doing compared to Keith and more interested in what kinds of conceptual models both Tonya and Keith have built so far. In other words, have they formed "strong constructions" or "weak constructions" (Noddings, 1990). Other constructivists speak of how "powerful" a student's constructions are.

The fundamental idea is that the purpose of assessment is to determine the nature of a student's constructions, so if any comparisons are made they would be made between that student and some model of how students might understand a certain concept or set of concepts. It is not a right/wrong proposition, nor can it easily lead to comparisons between or among students, since each student will put together meaning in a unique way. It is, by its very nature, an iterative process, in that the assessor is continually refining a model of the student's understanding, just as the student is continually adjusting his constructions to accommodate new experiences. It also relies heavily on extensive methods of data gathering and analysis from multiple sources, as in the case studies described earlier. The idea of administering an externally set instrument composed of multiple choice questions and, based upon that single instrument rank ordering students, is anathema to a constructivist. Neither the purpose nor the method would be acceptable. Likewise, gathering evidence about student understandings for the

purpose of assigning single letter or number grades does not fit a constructivist point of view. If these models of student understanding are complex, dynamic and unique, how can a single letter or number ever manage to convey the complexity of a model?

Constructivism, then, as a theory of how learning occurs, does not imply or prescribe particular assessment practices, and yet there are certain assessment practices that are more compatible with constructivism than they are with other theories of learning. The process of gathering evidence about what students have constructed and then making inferences based on that evidence is, from a constructivist point of view, a dynamic and complex process that requires the assessor to continuously adjust a model of the students' learning. It is most like the work of a cognitive researcher and is best accomplished by the teacher, or that person who knows the individual learner most deeply. It is a fallible process, just as the mathematics that it assesses is humanly constructed and fallible.

The NCTM Assessment Standards project

In the summer of 1993 the National Council of Teachers of Mathematics sponsored the gathering of writing teams to produce a working draft of assessment standards for school mathematics. The goal of the project is to produce a companion document to the two prior standards documents, the *Curriculum and Evaluation Standards* (NCTM, 1989) and the *Professional Standards for Teachers of Mathematics* (NCTM, 1991). This new document (hereafter referred to as the Assessment Standards) is designed to expand and enhance the evaluation standards from 1989, reflecting the expansion of experience and knowledge about assessment reform that has happened in the last five or six years.

The group that gathered in Park City, Utah to write the working draft was made up of 22 primary writers, with four others acting as consultants. Both the project director and the assistant project director are mathematics educators. Altogether the writers of the working draft were represented by nine mathematics educators, seven supervisors of mathematics for state or city public school systems, three classroom teachers, one director of a state assessment project, one member of a national assessment project in mathematics, and one cognitive psychologist. The consultants consisted of the president of NCTM, a mathematics educator, the director of a major educational research center, and a professional writer.

There were two preliminary meetings prior to the writing sessions in Utah, during which time the basic outline of the document was agreed upon. The writing sessions lasted for two weeks, followed by a break of ten days and then another two weeks. Following the writing sessions the project director and assistant project director edited the final version and a working draft was published in October, 1993.

What theoretical framework was used as a foundation for the writing of these standards? How did the writers decide on a common vision of assessment, with its associated notions of teaching and learning of mathematics? The answer is that the common vision, such as it is, evolved during the course of the writing, just as it is still evolving during the present rewriting and preparation for the final draft. But given that the writing team was so

largely represented by mathematics educators, and given the prevalence of a "sort of constructivist" theory of learning in the reform movement in mathematics education, the more interesting question may be, how much does this document reflect a constructivist point of view? I'd like to approach this question by revisiting the implications of constructivism for assessment described earlier, and explore how these compare with the vision of assessment reflected in the current working draft.

View of mathematics

Of the six standards that form the backbone of the document, the first most directly addresses the question of *what* is to be assessed. The first standard reads, "Assessment should reflect the mathematics that is most important for students to learn" (NCTM, 1993, p.27). The discussion of this standard argues that "important mathematics" should be reflected in all phases of the assessment process. However, the determination of exactly what constitutes "important mathematics" is left to others, though the advisement is that the *Curriculum Standards* should serve as a guide. As in that document, the mathematics described in the Assessment Standards emphasizes the processes of doing mathematics, rather than viewing it as a compilation of bits of knowledge (e.g., pp.31, 72, 83). The notion of mathematical power, first described in the *Curriculum Standards*, is prevalent here. The processes of problem solving, reasoning, making connections, and communicating are emphasized over the accumulation of bits of content knowledge.

Whether this emphasis on processes constitutes a view of mathematics that is consonant with relativistic fallibilism is not entirely clear. While the writers may allow for multiple ways of reaching solutions and may value the solving of nonroutine problems over the mastery of skills, this does not necessarily imply that the mathematics itself is socially constructed or fallible. A survey of the example tasks in the document shows that a few emphasize the mathematics that arises from cultural or social issues and see mathematics as a tool for solving socially embedded problems. For example, in the tasks that are described in the introductory vignette ("The College Jail Tale," p. 19-24) the students use mathematics to analyze such issues as the incarceration rates of black males. These tasks, however, are the exception rather than the rule. The majority of examples in the document do not represent socially embedded problems.

Assessment methods

In one sense the Assessment Standards emphasize the methods that would be endorsed by constructivist. The model-constructing done by the teacher that relies on multiple methods of gathering evidence is at the heart of the standards. From the purposes of instructional decision making to external validation of students, the message is that the classroom teacher is the one who knows the student best, and therefore the teacher should be intimately involved in assessment at all levels. The teacher is encouraged to use interviews, observations, and other methods associated with cognitive research.

On the other hand, allowances are still made for paper and pencil tests and for externally set instruments. Some of those mentioned, especially in Purposes 4, 5, and 6 are quite far removed from the realm of the researcher

who is constructing a model of student learning (district exams or the Advanced Placement tests, for example). A constructivist would reject these instruments, except as they might be used in conjunction with more intensive one-on-one methods, such as oral communication with the student (Mousley et al, 1992, p 135). In a classroom that is designed around constructivist principles, assessment would take the form of observing, listening to, and interacting with students. Tests or quizzes to be checked for correct answers would not be seen as useful (Yackel et al, 1992, p.78). The Assessment Standards, then, while valuing the teacher as the most informed assessor, and while pushing for more use of informal methods of assessment, do not go so far as to embrace methods that are totally in alignment with a constructivist view of learning.

Roles of teachers and students

The teachers and students who are portrayed in Purposes 1, 2, and 3 of the Assessment Standards are collaborators in the construction of models of student thinking. Students are asked to become self and peer evaluators, and teachers are asked to promote an atmosphere in which students have multiple opportunities to communicate their thinking. Teachers are expected to constantly listen to students and to record observations of students as they engage in mathematical activities. Students are expected to demonstrate what they know and can do through a variety of media and through multiple activities. The image of the classroom is one where students are making conjectures, reasoning, arguing, discussing, presenting, and creating many kinds of written products. Teachers facilitate this process and put together the multiple pieces of evidence in making valid inferences about what the student knows.

As consonant as these purposes may be with the roles of teachers and students implied by constructivism, there are some aspects of these purposes that are more at odds. For example, there is still quite a bit of allowance for traditional means of assessment described in several of the vignettes, and acknowledgement is given that grades must still be given in most schools. A more pure document would take a stronger stand against the collapsing of assessment information into a single letter or number grade, and would not allow for as many paper and pencil activities. In Purposes 4, 5, and 6 the vignettes include mathematical tasks that are very traditional paper and pencil types, and little or no mention is given to teachers' listening and observational data. In these purposes the reader would be hard pressed to find a constructivist point of view.

Purposes of assessment

Because of the intimate nature of assessment from a constructivist point of view, in that it involves one person building a model of another person's thinking, the farther the assessment gets from this one-on-one communication the less comfortable the constructivist will feel. In the Assessment Standards the purposes were built along a continuum, starting with the teacher in the classroom using assessment for instructional decisions and moving gradually out of the classroom to the evaluation of programs. The purposes where the kind of intimate assessment occurs is the first and second, Making

Instructional Decisions and Monitoring Student Progress. In both of these the teacher is seen as the leader and organizer, and the student plays an important role. With the caveats mentioned earlier, these purposes are most closely aligned with constructivism.

From Purpose 3 on, however, the movement is away from the evidence that can be gathered one on one, and the control is no longer in the teachers' and students' hands. Purpose 3, Summative Evaluations, includes discussions of producing letter grades, and the purpose is no longer directly to give feedback to the student or to the teacher. Now there are reports for others, such as parents or the public, and we are no longer in that instruction/learning loop. Beyond that, the purposes become centered on reports for outside interests, where the unit of analysis is often not the individual student but might be the classroom or the school or the state or the nation. When the movement is that far away from what an individual has constructed, it becomes almost impossible to maintain links back to that view of learning. True, there may be tasks that are more successful than others at providing evidence of student thinking, but these tasks alone could not be labeled either constructivist or non-constructivist. They could not be divorced from the purposes to which they are put and the way in which they are used.

Conclusion

> A foolish consistency is the hobgoblin of little minds, adored by little statesmen, philosophers and divines. (Emerson, 1841)

As I have described it, the Assessment Standards as a document could not be called either constructivist or nonconstructivist. There are elements of it that are consistent with constructivism (especially Purposes 1 and 2), but plenty of other areas that would make a constructivist uncomfortable. That is not to say that even Purposes 1 and 2 could be labeled as constructivist, only that what is written in those sections would not fundamentally contradict that view of learning. Does this mean, then, that as a document the Assessment Standards has no theoretical background, or that it has a hodge podge of theories of learning undergirding it?

Certainly one could not argue that the Assessment Standards stand on firm constructivist ground. Rather it uses some of the ideas of the "sort of" constructivism described in the introduction to this paper, and in that sense is very much aligned with other reform documents in mathematics education. This should not be a surprise, given the number of mathematics educators who were involved in the writing of the working draft. Like so many current products in mathematics education, the phrase "students construct their own knowledge" is used rather lightly, but the more serious implications of that point of view, as I have described them, are not visible in this working draft.

There is another important aspect at work in the production of the Assessment Standards that resulted in a rather inconsistent working draft. That is, it was written by 22 different people, organized into three working groups. These writers were not chosen for their strict adherence to the doctrine of constructivism, or to any other doctrine or theory. Admittedly, they were all chosen as people whose educational philosophies were generally

in line with the mathematics education reform movement, so at best they might represent the "sort of" constructivism. But of course it is inherently a political document and represents many hours of compromise among its writers, as well as opposing views that did not get compromised. This is most clearly seen in the differences among the writing groups, with the writers of the first three purposes being much more "constructivist-minded" than the writers of the other purposes.

How important is it that this document, given its nature and the diverse make up of its writers, present a consolidated and unified theory that undergirds it? In the end, I would argue, the pragmatic considerations of producing a document that not only speaks on behalf of a variety of people but also is trying to reach a diverse population, is more important than a document that is clearly grounded in one theory. I chose constructivism as a window to examine this document because of its prevalence in the reform literature, but had the writers of the standards begun with a constructivist stance they would have produced a very different document. Yet it would also have been limited in what it could say about assessment outside of that which occurs between teacher and student, and it might have been limited in the audience it could reach.

References

Confrey, J. (1990). What constructivism implies for teaching. In R.Davis, C.Maher & N.Noddings (Eds), Constructivist views on the teaching and learning of mathematics (pp.107-124). *Journal for Research in Mathematics Education Monograph, 4.*

Emerson, R.W. (1841). *Essays: First series.*

Ernest, P. (1991). *The psychology of mathematics education.* London: Falmer.

Findley & Scates (1946). Measuring understanding in elementary mathematics. In N.Henry (Ed.), *The measurement of understanding. Forty-fifth yearbook of the National Society for the Study of Education.* Chicago, Ill: U. of Chicago Press.

Galbraith, P. (1993). Paradigms, problems and assessment: Some ideological implications. In M. Niss (Ed), *Investigations into assessment in mathematics education: An ICMI study* (pp. 73-86). Dordrecht: Kluwer.

Goldin, G. (1990). Epistemology constructivism, and discovery learning in mathematics. In R.Davis, C.Maher & N.Noddings (Eds), Constructivist views on the teaching and learning of mathematics (pp.31-50). *Journal for Research in Mathematics Education Monograph, 4.*

Graue, M.E. (1993). Integrating theory and practice through instructional assessment. *Educational Assessment, 1(4),* 283-310.

Kilpatrick, J. (1987). What constructivism might be in mathematics education. In J.Bergeron, N. Herscovics, & C. Kieran (Eds), *Proceedings of the Eleventh international Conference on the Psychology of Mathematics Education* (pp.3-27). Montreal, Canada: PME.

Mousley, J., Clements, M.A., & Ellerton, N. (1993) Teachers' interpretations of their roles in mathematics classrooms. In G.Leder (Ed.), *Assessment and learning of mathematics* (pp. 107-144). Victoria, Australia: Australian Council for Educational Research.

National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (1993). *Assessment standards for school mathematics: Working draft.* Reston, VA: Author.

National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics.* Reston, VA: Author.

Nodding, N. (1990). Constructivism in mathematics education. In R.Davis, C.Maher & N.Noddings (Eds), Constructivist views on the teaching and learning of mathematics (pp.7-18). *Journal for Research in Mathematics Education Monograph, 4.*

Romberg, Zarinnia & Collis (1990). A new world view of assessment in mathematics. In G.Kulm (Ed.), *Assessing higher order thinking in mathematics* (pp. 21-39). Washington, DC: AAAS.

Simon, M. (in press). Reconstructing mathematics pedagogy from a constructivist perspective. *Journal for Research in Mathematics Education*.

Steffe, L. & Wiegel, J. (1992). On reforming practice in mathematics education. *Educational Studies in Mathematics, 23*.

Sullivan, P. & Clarke, D.J. (1991). *Communication in the classroom: The importance of good questioning*. Victoria, Australia: Deakin U. Press.

von Glaserfeld, E. (1991). An exposition of constructivism: Why some like it radical. In R.Davis, C.Maher & N.Noddings (Eds), Constructivist views on the teaching and learning of mathematics (pp.19-30). *Journal for Research in Mathematics Education Monograph, 4*.

Yackel, E., Cobb, P., & Wood, T. (1993). Instructional development and assessment from a socioconstructivist perspective. In G.Leder (Ed.), *Assessment and learning of mathematics* (pp. 63-82). Victoria, Australia: Australian Council for Educational Research.